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Evaluating the Financial Sustainability of Pakistan Post Office Using a Machine Learning Approach: Implications for Sustainable Development Goals

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Abstract

Financial sustainability has become a critical challenge for public sector service institutions and State-Owned enterprises (SOEs), particularly in sectors experiencing structural transformation due to technological change and increasing market competition. This study evaluates the financial sustainability of the Pakistan Post Office by employing a data-driven analytical framework that integrates composite sustainability indices and econometric modeling. The analysis is based on twenty years of annual data and utilizes key financial performance indicators, including Return on Assets (ROA), Return on Equity (ROE), Net Profit Margin (NPM), and Fixed Asset Turnover (FAT). These indicators are normalized using the Min–Max technique and aggregated to construct three composite indices: the Financial Sustainability Index (FSI), the Financial Vulnerability Index (FVI), and the Operational Efficiency Index (OEI). These indices are further combined to develop an Aggregate Financial Sustainability Index (AFSyI), which provides a comprehensive measure of the overall financial sustainability of Pakistan Post Office.

To examine the determinants of financial sustainability, an Ordinary Least Squares (OLS) regression model is implemented within a Python-based computational environment using fiscal policy variables such as revenue, expenditure, fiscal deficit, and interest rates as explanatory factors. The empirical results indicate that financial sustainability in the postal sector has remained moderate but unstable over the study period. Government expenditure and fiscal deficit demonstrate statistically significant positive relationships with financial sustainability, while interest rates do not exhibit a significant influence. The findings suggest that fiscal policy conditions and government financial support play an important role in sustaining the operations of public postal institutions.

The study further highlights that strengthening the financial sustainability of Pakistan Post is crucial, as its declining performance mirrors the broader challenges faced by State-Owned Enterprises (SOEs) in Pakistan. Institutional economics suggests that economic outcomes are shaped by governance, laws, and social norms, and that public institutions can improve efficiency and sustainability through effective management. Enhancing operational efficiency, institutional effectiveness, and financial management in Pakistan Post can support SDGs 5, 8, and 9 by promoting financial inclusion, employment, economic activity, and robust logistics and communication infrastructure. These findings provide empirical evidence to guide policy reforms aimed at modernizing postal institutions and strengthening their role in sustainable economic development

Keywords: Financial sustainability, Pakistan Post Office, Machine learning, Composite indices, Institutional Economics, State-Owned Enterprise, Institutional Effectiveness, Sustainable Development Goals

Introduction

Public sector service institutions play a critical role in national economic development by providing essential infrastructure that supports communication, financial transactions, and the movement of goods and information. Among these institutions, postal systems have historically served as one of the most extensive public service networks connecting individuals, businesses, and government agencies. Even in the digital age, postal networks remain an important component of national infrastructure, particularly in developing countries where they provide logistical services, financial access, and communication channels across geographically dispersed populations (Universal Postal Union, 2021).

Globally, postal services contribute to economic activity by facilitating trade, supporting small and medium enterprises, and expanding access to financial services in underserved regions. The Universal Postal Union notes that postal networks represent one of the largest physical distribution infrastructures in the world, with hundreds of thousands of post offices providing services to billions of people (Universal Postal Union, 2021). Because of their extensive reach, postal institutions often serve as platforms for financial inclusion, government service delivery, and rural economic integration.

In Pakistan, the postal sector plays an important role in maintaining communication and financial service accessibility across urban and rural regions. Pakistan Post Office, operating under the Ministry of Communications, manages a nationwide network of post offices providing mail delivery, logistics, savings schemes, and remittance services to citizens throughout the country (Government of Pakistan, 2022). This network enables individuals and businesses to exchange goods, services, and financial resources, particularly in remote areas where alternative service providers may be limited.

However, postal organizations around the world are facing increasing operational and financial challenges. The rapid expansion of digital communication technologies has significantly reduced the demand for traditional mail services, which historically constituted a major source of revenue for postal operators (Crew & Kleindorfer, 2012). At the same time, the growth of private courier companies and digital logistics platforms has intensified competition within the delivery and logistics sector. These structural changes have forced many postal operators to reassess their operational models and financial strategies in order to remain sustainable.

Financial sustainability is a critical concern for public service organizations, including national postal systems and other state-owned enterprises, as it determines their ability to maintain continuous service delivery while effectively managing financial and operational resources. It refers to the capacity of an organization to sustain its operations over the long term through efficient revenue generation, prudent financial management, and effective cost control (Epstein & Buhovac, 2014). For public institutions, financial sustainability is essential because their ability to deliver reliable services depends largely on stable financial performance and efficient utilization of available resources

From the perspective of institutional economics, economic performance is shaped by governance systems, laws, and social norms as well as market forces. Early economists like Thorstein Veblen emphasized that behavior evolves within changing institutional environments (Hodgson, 2012). For public institutions and SOEs, strong governance and regulatory frameworks are crucial for efficiency and long-term financial sustainability (North, 1990), Additionally, SOEs can act as active institutional actors, with their management and leadership influencing institutional structures and overall organizational performance (Butzbach et al., 2022). In the context of Pakistan, the financial sustainability of State-Owned Enterprises (SOEs) is particularly important due to the fiscal pressures

created by inefficient operations, overstaffing, and heavy reliance on government subsidies.

Efficient operation and sufficient revenue generation by SOEs enable them to contribute positively to economic growth, invest in modernization, and enhance service delivery. Strengthening financial management, accountability, and governance frameworks such as those established under the SOEs Act of 2023 is therefore essential to ensure the long-term viability and effective performance of public sector enterprises in Pakistan (Samad & Faraz, 2024). Specifically, improving financial management, transparency, and accountability through the reforms introduced by the SOEs Act of 2023 can enhance operational efficiency, reduce fiscal risks, and support the sustainable performance of these enterprises.

Evaluating the financial sustainability of an organization requires careful analysis of financial performance indicators that reflect profitability, efficiency, and asset utilization. Commonly used financial indicators include Return on Assets (ROA), Return on Equity (ROE), Net Profit Margin, and Fixed Asset Turnover, which measure how effectively an organization uses its resources to generate financial returns (Brigham & Houston, 2019). These indicators provide important insights into the operational efficiency and financial stability of institutions.

While individual indicators provide valuable information, analyzing financial sustainability through a single metric may not capture the multidimensional nature of organizational performance. As a result, researchers increasingly employ composite index approaches that combine multiple indicators into a unified measure of performance. Composite indices are widely used in economic and sustainability research because they allow complex phenomena to be evaluated through aggregated indicators that reflect multiple dimensions of performance (OECD, 2008).

In the context of public sector institutions, financial sustainability is also influenced by broader macroeconomic and fiscal policy conditions. Government fiscal variables such as public revenue, expenditure patterns, fiscal deficits, and interest rates shape the economic environment within which public organizations operate. These fiscal conditions can affect resource allocation, operational funding, and long-term financial stability (Blanchard, 2017). Understanding the relationship between fiscal variables and institutional financial sustainability is therefore important for evaluating the broader policy environment affecting public organizations.

The increasing availability of digital tools and computational methods has significantly expanded the ability of researchers to analyze financial and economic data. Programming environments such as Python are widely used in economic research for data processing, statistical analysis, and econometric modeling. These tools enable researchers to analyze complex datasets and implement data-driven analytical frameworks that improve the accuracy and transparency of empirical analysis (Müller & Guido, 2016). The integration of computational approaches into economic research also reflects the broader digital transformation occurring across many sectors of the economy.

Strengthening the financial sustainability of public institutions such as postal systems can contribute to broader sustainable development objectives. The United Nations 2030 Agenda for Sustainable Development emphasizes the importance of inclusive economic growth, employment creation, and technological development (United Nations, 2015). In particular, SDG 8 focuses on promoting sustained economic growth and productive employment. Postal institutions often employ large numbers of workers and support commercial activity through logistics and communication services, making them important contributors to economic development.

Similarly, SDG 9 emphasizes the importance of industrial innovation and infrastructure in supporting sustainable development. Postal networks represent an important component of national logistics infrastructure, and improvements in operational efficiency and digital transformation within postal systems can contribute to broader industrial and technological development. In addition, postal financial services may contribute to SDG 5, which aims to promote gender equality and women's empowerment, by expanding access to financial services and economic opportunities for women in

underserved communities (Demirgüç-Kunt et al., 2018).

Despite the economic and social importance of postal institutions, relatively limited research has examined the financial sustainability of postal systems in developing countries using integrated analytical frameworks. In the case of Pakistan Post Office, existing studies have largely focused on service modernization and operational reforms, while fewer studies have systematically evaluated financial sustainability using comprehensive financial indicators and macroeconomic variables.

Therefore, this study aims to evaluate the financial sustainability of Pakistan Post Office by analyzing key financial performance indicators and constructing composite sustainability indices. The study further examines how fiscal policy variables influence financial sustainability and explores the potential contribution of improved financial sustainability in the postal sector to broader sustainable development objectives.

Methodology

Research Framework

This study employs a data-driven analytical framework combining composite sustainability indices and machine-learning-based predictive modeling to evaluate the financial sustainability of Pakistan Post Office. The framework integrates financial performance indicators, macroeconomic variables, and fiscal policy indicators in order to examine how financial sustainability evolves over time and how it is influenced by fiscal conditions.

Recent developments in computational economics and data science have encouraged researchers to employ machine learning techniques for financial analysis and prediction. Machine learning methods enable researchers to identify relationships between variables, improve predictive accuracy, and analyze complex datasets using computational algorithms (Müller & Guido, 2016; Hastie, Tibshirani, & Friedman, 2009). In the present study, Python is used as the computational environment for implementing the data preprocessing, index construction, and predictive modeling stages.

The methodological framework consists of three major analytical components. First, key financial indicators are analyzed to evaluate the financial performance of Pakistan Post Office. Second, normalized indicators are aggregated to construct composite sustainability indices. Third, a machine-learning-based regression model is employed to analyze the influence of fiscal policy variables on financial sustainability.

Data and Variables

The empirical analysis is based on annual time-series data covering a period of twenty years. The dataset includes financial performance indicators of Pakistan Post Office as well as macroeconomic and fiscal variables representing the broader economic environment.

The financial indicators used to evaluate organizational performance include Return on Assets (ROA), Return on Equity (ROE), Net Profit Margin (NPM), and Fixed Asset Turnover (FAT). These indicators are commonly used in financial analysis because they measure profitability, asset efficiency, and capital utilization (Brigham & Houston, 2019).

In addition to financial indicators, the study incorporates macroeconomic and operational variables including debt-to-equity ratio, inflation rate, GDP growth, current ratio, operating expenses, operating profit, and fixed turnover. These variables capture financial stability and operational performance conditions that may affect institutional sustainability.

The analysis also includes fiscal policy variables such as government revenue, government expenditure, fiscal deficit, and interest rates. Fiscal variables are important determinants of public sector financial conditions and may influence the sustainability of government institutions (Blanchard, 2017).

Data Preprocessing and Normalization

Since the indicators included in the dataset are measured in different units and scales, the data must be normalized before aggregation. Following standard procedures in composite index construction,

the study applies Min–Max normalization to rescale each variable into a standardized range between zero and one (Shantal et. al.,2023).
The normalized value is calculated using the following transformation:

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

This normalization method preserves the relative distribution of values while allowing variables measured in different units to be aggregated within composite indices. The normalization process was implemented using Python data-processing libraries.

Construction of Composite Sustainability Indices

To evaluate financial sustainability in a multidimensional framework, three composite indices are constructed in this study.
The Financial Sustainability Index (FSI) measures internal financial performance using normalized values of ROA, ROE, Fixed Asset Turnover, and Net Profit Margin. These indicators collectively reflect the organization's ability to generate financial returns and efficiently utilize assets.

$$FSI = \frac{ROA_{norm} + ROE_{norm} + FAT_{norm} + NPM_{norm}}{4}$$

The Financial Vulnerability Index (FVI) captures broader financial and macroeconomic conditions affecting institutional sustainability. The index incorporates normalized macroeconomic indicators including debt-to-equity ratio, inflation rate, GDP growth, and current ratio.
The Operational Efficiency Index (OEI) evaluates the operational performance of Pakistan Post Office using normalized indicators including operating expenses, operating profit, and fixed turnover.

Aggregate Financial Sustainability Index

To obtain a comprehensive measure of sustainability, the three composite indices are combined to construct the Aggregate Financial Sustainability Index (AFSyI)(Cheang & Choy,2011). This index integrates financial performance, macroeconomic conditions, and operational efficiency into a single sustainability measure.

$$AFSyI = \frac{FSI + FVI + OEI}{3}$$

The AFSyI serves as the target variable in the machine learning model, representing the overall financial sustainability of Pakistan Post Office.

Machine Learning Model

To examine the relationship between fiscal policy variables and financial sustainability, this study employs a supervised machine learning approach based on regression modeling. In supervised learning, the algorithm learns the relationship between input variables (features) and an output variable (target) from historical data.
In this study, the input variables consist of fiscal policy indicators including revenue, expenditure, fiscal deficit, and interest rate, while the target variable is the Aggregate Financial Sustainability Index (AFSyI).
The predictive relationship can be expressed as:

$$AFSyI = f(Revenue, Expenditure, Deficit, InterestRate)$$

The regression model is implemented using Python statistical libraries, which allow efficient model estimation and evaluation. The model is trained using the historical dataset in order to estimate the relationship between fiscal policy variables and financial sustainability.

Computational Implementation

The empirical analysis was conducted using the Python programming environment, which provides an integrated platform for data processing, statistical modeling, and visualization. Python has become increasingly popular in financial and economic research because it allows researchers to efficiently handle large datasets, perform advanced statistical analysis, and generate graphical outputs within a single computational framework (Müller & Guido, 2016).

In this study, several Python libraries were utilized to implement the analytical procedures. The Pandas library was used for data preprocessing, dataset management, and manipulation of time-series data. Numerical operations and array-based computations were performed using NumPy, which provides efficient mathematical functions for handling large datasets. For econometric estimation and regression modeling, the study employed Statsmodels and Scikit-learn, which provide a wide range of statistical tools and machine learning algorithms suitable for empirical economic analysis (Ahmed,2024). Finally, graphical visualization of the results, including index trends and regression diagnostics, was conducted using Matplotlib and Seaborn, which allow the generation of clear and informative figures for empirical interpretation.

The integration of these libraries within the Python environment enabled the systematic implementation of data normalization, composite index construction, econometric modeling, and graphical analysis. This computational framework enhances the transparency and reproducibility of the empirical results presented in this study.

Results

Overview of Financial Sustainability Indices

This section presents the empirical results obtained from the composite indices and econometric analysis described in the methodology. The results are organized into three parts. First, descriptive statistics summarize the statistical properties of the constructed indices. Second, the temporal behavior of the indices is examined through graphical analysis. Finally, regression results are presented to evaluate the relationship between fiscal variables and financial sustainability.

Descriptive Statistics of Sustainability Indices

Table 4.1 reports the descriptive statistics of the Financial Soundness Index (FSI), Financial Vulnerability Index (FVI), Operational Efficiency Index (OEI), and the Aggregate Financial Sustainability Index (AFSyI) for the period 2005–2024.

Table 4.1 Descriptive Statistics of Composite Indices

Index	Observations	Mean	Std. Dev.	Minimum	Maximum
FSI	20	0.369	0.120	0.169	0.623
FVI	20	0.505	0.134	0.137	0.682
OEI	20	0.484	0.136	0.239	0.719
AFSyI	20	0.453	0.093	0.273	0.649

The descriptive statistics indicate moderate variation in all indices over the study period. Among the indices, the Financial Soundness Index shows the lowest mean value, suggesting that profitability and asset utilization remained relatively constrained throughout the sample period. In contrast, the Financial Vulnerability Index exhibits a higher mean value and wider dispersion, reflecting fluctuations in macroeconomic and fiscal conditions affecting the financial environment. The Aggregate Financial Sustainability Index shows comparatively lower dispersion, which is expected because it aggregates multiple indicators. However, the observed variability suggests sufficient variation in sustainability outcomes to support econometric estimation.

Temporal Behaviour of Financial Sustainability

Financial Soundness Index

Figure 4.1(a) shows the time trend of the Financial Soundness Index. The index fluctuates substantially during the study period, indicating variations in profitability and asset efficiency. Although several short periods of improvement are visible, these increases are not consistently sustained across time. The pattern suggests that financial performance improvements occurred intermittently rather than through a stable upward trajectory.

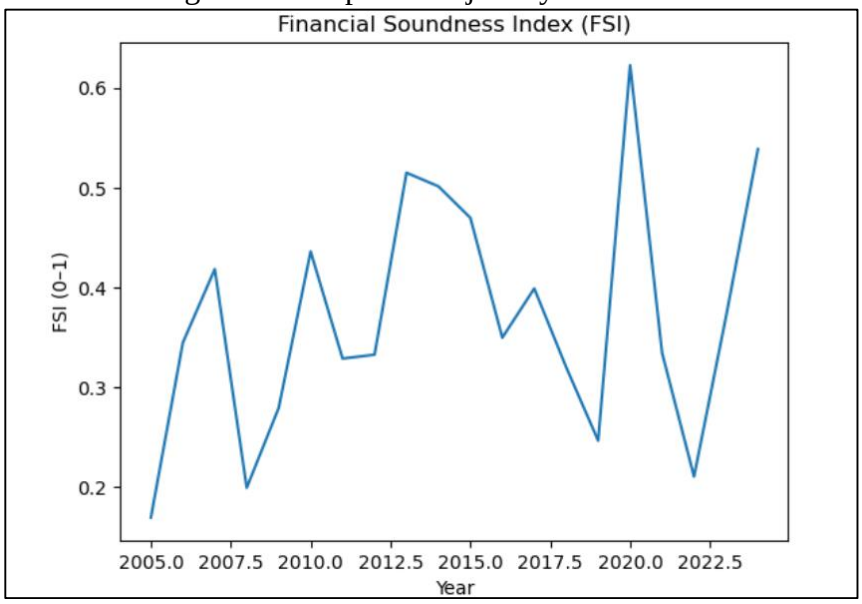

Figure 4.1a: Financial soundness index (FSI)

Financial Vulnerability Index

The trend of the Financial Vulnerability Index is presented in Figure 4.1(b). The index exhibits noticeable shifts across the sample period, reflecting changing macroeconomic conditions and fiscal pressures. Higher values correspond to periods characterized by increased financial vulnerability, while temporary declines indicate improvements in external financial conditions. The overall pattern suggests that exposure to macroeconomic and fiscal risks remained a persistent feature throughout the period of analysis.

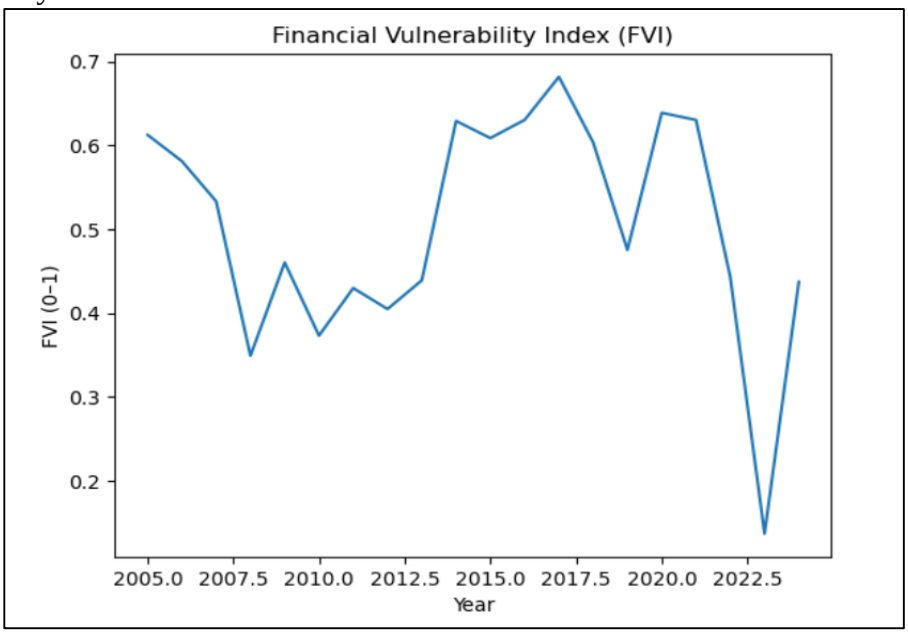

Figure 4.1b: Trend of Financial Vulnerability Index (FVI)

Operational Efficiency Index

Figure 4.1(c) illustrates the behaviour of the Operational Efficiency Index. The index demonstrates moderate improvement during some years, indicating episodes of improved operational performance and cost efficiency. However, these improvements are interspersed with declines, suggesting that gains in operational efficiency were not consistently maintained over time.

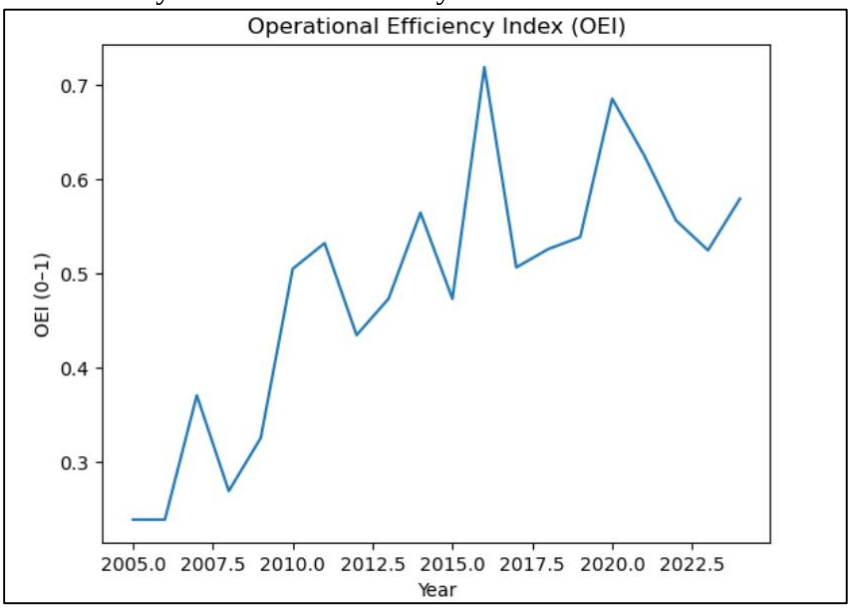

Figure 4.1c: Trend of Operational Efficiency Index (OEI)

Aggregate Financial Sustainability Index

The combined effect of financial soundness, vulnerability, and operational efficiency is captured in Figure 4.1(d). The Aggregate Financial Sustainability Index shows moderate fluctuations across the study period, reflecting the interaction of internal performance and external financial conditions. While some periods exhibit improvements in overall sustainability, the index does not display a persistent upward trend, indicating that financial sustainability remained uneven over time.

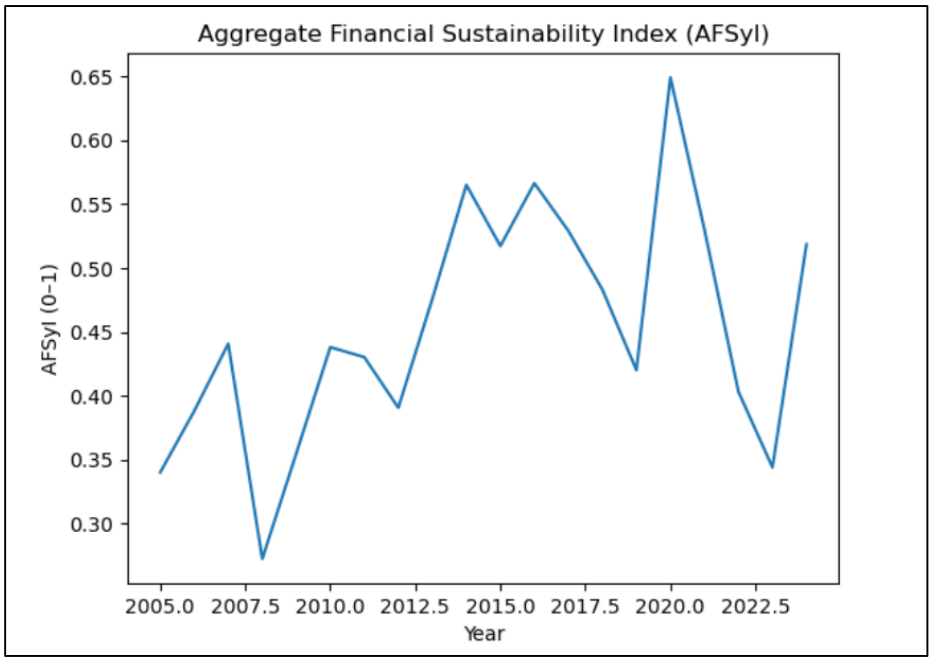

Figure 4.1d: Aggregate Financial Sustainability Index (AFSyI)

Regression Results

The regression model estimates the relationship between fiscal variables and the Aggregate Financial Sustainability Index (AFSyI), which represents the overall financial sustainability of Pakistan Post Office. The model includes four explanatory variables: revenue, expenditure, fiscal deficit, and interest rate. The regression results are reported in Table 4.2.

Table 4.2 OLS Regression Results

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Constant	0.3441	0.089	3.851	0.002
Revenue	-3.01×10^{-5}	1.49e−05	−2.027	0.061
Expenditure	3.91×10^{-5}	1.34e−05	2.914	0.011
Deficit	3.41×10^{-5}	1.39e−05	2.447	0.027
Interest Rate	−0.0012	0.007	−0.187	0.854

The overall performance of the regression model indicates that the selected fiscal variables explain a meaningful portion of the variation in financial sustainability. The R^2 value of 0.592 suggests that approximately 59.2% of the variation in the Aggregate Financial Sustainability Index is explained by the independent variables included in the model. In the context of social science and institutional studies, this represents a relatively strong explanatory power given the limited sample size and the complexity of financial sustainability dynamics. The statistical significance of the overall regression model is confirmed by the F-statistic, which indicates that the explanatory variables collectively have a statistically significant relationship with financial sustainability. In other words, the fiscal variables included in the model jointly contribute to explaining variations in the sustainability performance of Pakistan Post Office.

The constant term in the regression equation has a coefficient value of 0.3441, which is statistically significant at the 1 percent level (p = 0.002). This coefficient represents the expected value of the Aggregate Financial Sustainability Index when all explanatory variables are equal to zero. Although the intercept does not have a direct economic interpretation in this context, its statistical significance suggests that the baseline level of financial sustainability remains positive even when the fiscal variables are not considered. This reflects the inherent operational structure and baseline financial capacity of Pakistan Post Office.

Revenue

The revenue variable has a negative coefficient (-3.01×10^{-5}) and is marginally significant at the 10 percent level (p = 0.061). The negative sign indicates that increases in revenue are associated with a slight decrease in the Aggregate Financial Sustainability Index. At first glance, this relationship may appear counterintuitive, as higher revenue is generally expected to improve financial sustainability. However, in the context of Pakistan Post Office, this result may reflect structural characteristics of the postal sector. Revenue growth in public postal organizations often occurs alongside rising operational costs, infrastructure investments, and service expansion obligations. As a result, increases in revenue may not necessarily translate into improved financial sustainability if the associated costs increase at a faster rate. Additionally, revenue growth in public sector service organizations may reflect increased service obligations rather than improved financial performance. This finding therefore suggests that revenue expansion alone is insufficient to strengthen the financial sustainability of Pakistan Post Office unless it is accompanied by improvements in cost efficiency and operational management.

Expenditure

Government expenditure exhibits a positive coefficient (3.91×10^{-5}) and is statistically significant at the 5 percent level (p = 0.011). This indicates that increases in government expenditure are associated with improvements in the Aggregate Financial Sustainability Index. The positive relationship suggests that higher levels of expenditure may contribute to improved financial sustainability by supporting operational activities, infrastructure investment, and institutional stability. In the context of a public-sector postal organization, government spending may provide financial support through subsidies, investment in logistics infrastructure, or modernization initiatives. Such expenditures can enhance service capacity, improve operational efficiency, and stabilize financial performance. Therefore, the positive coefficient implies that government financial support plays an important role in sustaining the operations of Pakistan Post Office and maintaining its financial viability.

Fiscal Deficit

The fiscal deficit variable also shows a positive and statistically significant coefficient (3.41×10^{-5}) with a p-value of 0.027, indicating significance at the 5 percent level. This result suggests that increases in fiscal deficit are associated with improvements in the financial sustainability index. Although deficits are typically interpreted as indicators of fiscal imbalance, this result reflects the specific financing structure of public sector organizations. In many cases, fiscal deficits represent government financing used to support public services. For institutions such as Pakistan Post Office, deficit financing may provide the necessary financial resources to maintain service delivery, invest in operational infrastructure, and offset financial losses arising from declining traditional mail services. Therefore, the positive coefficient suggests that fiscal deficits may indirectly support the sustainability of Pakistan Post Office through government financial intervention.

Interest Rate

The interest rate variable has a negative coefficient (-0.0012) but is statistically insignificant (p = 0.854). This indicates that changes in interest rates do not have a statistically meaningful effect on the Aggregate Financial Sustainability Index. The lack of significance may be explained by the institutional financing structure of Pakistan Post Office. Public sector organizations often rely on

government financing arrangements or concessional borrowing mechanisms that are not directly influenced by market interest rate fluctuations. Consequently, variations in interest rates may not significantly affect the financial performance or sustainability of the organization during the study period.

Overall, the regression results suggest that fiscal policy variables play an important role in shaping the financial sustainability of Pakistan Post Office. In particular, government expenditure and deficit financing appear to provide important financial support that helps maintain operational stability. At the same time, the negative relationship between revenue and sustainability highlights the structural challenges faced by the postal sector. Revenue growth alone may not be sufficient to improve financial sustainability if it is accompanied by rising operational costs and structural inefficiencies. These findings emphasize the importance of financial restructuring, operational efficiency improvements, and government support mechanisms for institutional effectiveness and strengthening the long-term sustainability of Pakistan Post Office.

Regression Diagnostics

Actual vs Fitted Values

Figure 4.2 compares the predicted values of the sustainability index with the observed values. The fitted values closely follow the observed pattern, indicating that the regression model captures a meaningful portion of the variation in financial sustainability.

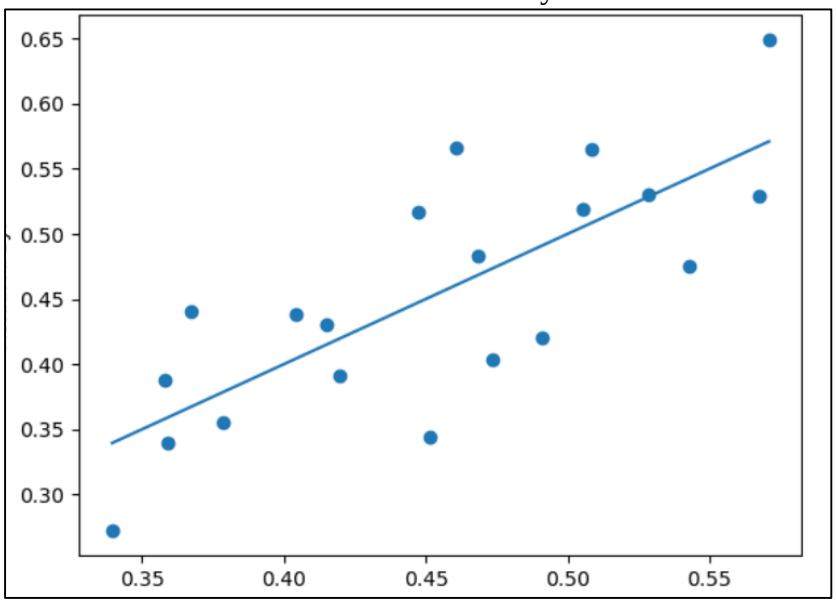

Figure 4.2: Actual Vs Fitted Value

Normality of Residuals

The Q–Q plot presented in Figure 4.3 indicates that the residuals approximately follow a normal distribution, as most observations lie close to the reference line.

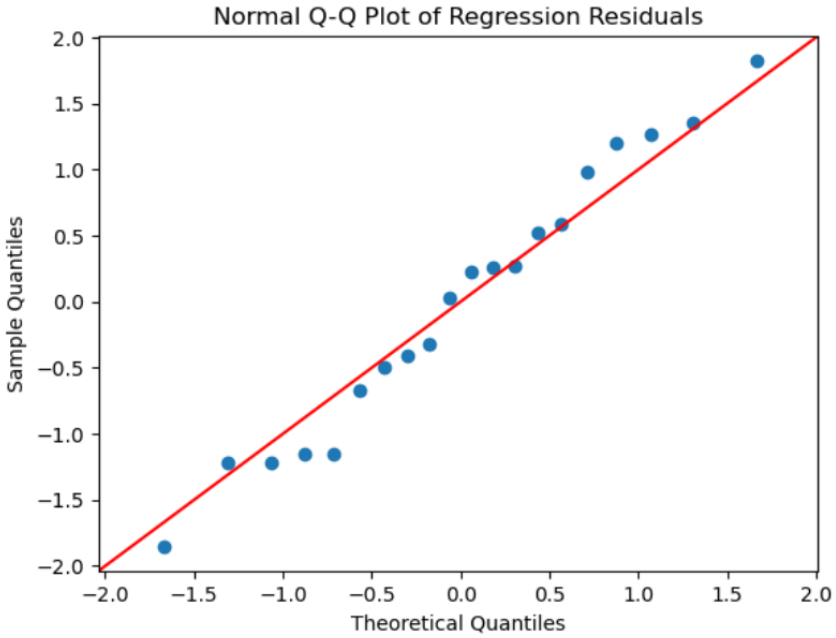

Figure 4.3: Normal Q-Q plot of Regression Residuals

Discussion and Conclusion

Discussion

The empirical results of this study provide important insights into the financial sustainability of Pakistan Post Office and the fiscal factors influencing its performance. By constructing composite indices representing financial soundness, financial vulnerability, and operational efficiency, the analysis offers a multidimensional assessment of institutional sustainability. The results reveal that the financial sustainability of Pakistan Post Office has remained moderate but unstable over the study period, reflecting fluctuations in internal financial performance, macroeconomic conditions, and operational efficiency.

The descriptive statistics indicate that the Financial Soundness Index (FSI) has the lowest mean value among the indices, suggesting persistent limitations in profitability and asset utilization. This finding aligns with broader evidence indicating that traditional postal operators worldwide have experienced declining revenues from conventional mail services due to the rapid expansion of digital communication technologies and electronic alternatives (Crew & Kleindorfer, 2012). As traditional mail volumes decline, postal organizations must increasingly rely on alternative services such as logistics, parcel delivery, and financial services to maintain financial viability.

The results also demonstrate that the Financial Vulnerability Index (FVI) exhibits significant variability across the study period, reflecting the sensitivity of institutional performance to macroeconomic and fiscal conditions. This observation is consistent with the literature emphasizing that public sector organizations operate within broader macroeconomic environments that influence resource allocation, operational funding, and institutional sustainability (Blanchard, 2017). Changes in inflation, fiscal deficits, and economic growth conditions can therefore affect the financial stability of public institutions such as postal operators.

Similarly, the Operational Efficiency Index (OEI) indicates fluctuations in operational performance across the study period. While temporary improvements in efficiency are observed in certain years, the absence of a consistent upward trend suggests that efficiency gains have not been institutionalized over the long term. Operational efficiency is widely recognized as a critical determinant of sustainability in public service organizations because inefficient resource utilization can generate

persistent financial pressures (Epstein & Buhovac, 2014). The results therefore highlight the importance of operational reforms and management improvements in strengthening institutional sustainability.

The Aggregate Financial Sustainability Index (AFSyI), which integrates the three sustainability dimensions, demonstrates moderate variation over time without a clear long-term upward trend. This finding suggests that improvements in one dimension of sustainability are often offset by weaknesses in other areas. For example, temporary improvements in operational efficiency may be accompanied by deteriorating financial conditions or increased macroeconomic vulnerability. Such dynamics highlight the complex and multidimensional nature of financial sustainability in public sector organizations.

The regression analysis further provides insight into the fiscal determinants of financial sustainability. The results indicate that government expenditure has a positive and statistically significant relationship with the sustainability index. This finding suggests that higher levels of expenditure, potentially reflecting government support or investment in operational activities, contribute positively to financial sustainability. In the context of public sector organizations, government expenditure often plays an important role in maintaining service delivery and supporting institutional operations (Blanchard, 2017).

Similarly, the positive relationship between fiscal deficit and financial sustainability may reflect the role of government deficit financing in supporting the operations of public institutions. Although deficits are typically viewed as indicators of fiscal imbalance, deficit financing in the public sector may provide temporary financial support to sustain essential services. This observation highlights the distinctive financial dynamics of public sector organizations, where sustainability may depend on government support rather than purely market-based revenue generation.

In contrast, the interest rate variable does not show a statistically significant relationship with financial sustainability. This result may reflect the institutional financing structure of Pakistan Post Office, where borrowing conditions may be influenced by government policy or concessional lending arrangements rather than market-based interest rates. As a result, variations in interest rates may not directly affect the financial sustainability of the organization.

The findings of this study also have important implications for broader sustainable development objectives. Postal systems are widely recognized as key components of national infrastructure and play an important role in facilitating economic activity and financial inclusion (Universal Postal Union, 2021). Strengthening the financial sustainability of Pakistan Post Office can therefore contribute to Sustainable Development Goal 8, which emphasizes sustained economic growth and productive employment. Postal services support economic activity by facilitating logistics, communication, and financial transactions that enable businesses and individuals to participate in economic markets.

Furthermore, improvements in operational efficiency and institutional performance can contribute to Sustainable Development Goal 9, which promotes industrial innovation and infrastructure development. Modern postal systems increasingly serve as logistics platforms for e-commerce and digital trade, making them important components of national infrastructure in the digital economy (Universal Postal Union, 2021). Enhancing the operational capabilities and financial stability of postal institutions may therefore support technological innovation and economic connectivity.

Financial sustainability in the postal sector may also indirectly support Sustainable Development Goal 5, which focuses on gender equality and women's empowerment. Postal financial services have been identified as important channels for expanding access to financial services for underserved populations, including women in rural and marginalized communities (Demirgüç-Kunt et al., 2018). By providing accessible financial services and payment systems, postal networks can support women's economic participation and entrepreneurship. Overall, the results highlight the importance

of financial sustainability for the long-term viability of public service institutions and their contribution to broader economic and social development objectives.

Conclusion

This study evaluated the financial sustainability of Pakistan Post Office by constructing composite indices representing financial soundness, financial vulnerability, and operational efficiency. The indices were combined to form an Aggregate Financial Sustainability Index, which was used to examine the overall sustainability performance of the organization. The empirical analysis also investigated the influence of fiscal policy variables, including revenue, expenditure, fiscal deficit, and interest rates, on financial sustainability using regression analysis.

The results indicate that the financial sustainability of Pakistan Post Office has remained moderate but uneven over the study period. Internal financial performance, macroeconomic conditions, and operational efficiency exhibit considerable variability across years, highlighting the multidimensional nature of institutional effectiveness and sustainability. Although temporary improvements in financial performance and operational efficiency are observed in some periods, the absence of a consistent upward trend suggests that long-term sustainability challenges persist.

The econometric analysis shows that government expenditure and fiscal deficit are positively associated with financial sustainability, while the interest rate variable does not have a significant effect. These findings suggest that fiscal policy conditions play an important role in shaping the sustainability outcomes of public sector institutions. In particular, government expenditure appears to provide important support for sustaining operational activities and financial performance.

From a broader perspective, the financial sustainability of Pakistan Post Office has implications for national development objectives and sustainable development goals. Strengthening the financial performance and operational efficiency of postal institutions can support economic growth, infrastructure development, and financial inclusion. In this context, improving the sustainability of Pakistan Post Office may contribute to achieving SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), and SDG 5 (Gender Equality).

Future policy efforts should therefore focus on improving operational efficiency, expanding revenue-generating services, and strengthening financial management within the postal sector through the lens of institutional economics. In addition, continued modernization and digital transformation may help postal sector adapt to changing market conditions, institutional effectiveness and enhance their contribution to national development.

Overall, this study demonstrates the usefulness of composite sustainability indices and data-driven analysis in evaluating the financial sustainability of public sector institutions. The findings provide empirical evidence that can support policy discussions on the modernization and sustainability of postal services in Pakistan and other developing economies.

Data Availability Statement

The data used in this study are available from the corresponding author upon reasonable request.

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Declaration of Competing Interest

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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